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54 Optical testing device for tires

57 The present invention relates to a testing apparatus for tires with a positioning device for the tire to be tested (3) and a laser testing device. According to the invention, the testing device comprises several measuring heads (9-12), especially laser measuring heads, in order to shorten the cycle time. According to one aspect of the invention, several observation units and associated illumination sources are integrated into each measuring head.

Description

[0001] The innovation relates to a testing apparatus for tires with a positioning device for the tire to be tested and with a testing device, especially a laser testing device.

[0002] Testing apparatuses of this type are already known in practice. They can be arranged in a pressure chamber or vacuum chamber. The positioning device preferably consists of a placement table with an opening, e.g. a circular opening, in the area of which the testing device, especially a laser testing device, is located. The laser testing device can also be run down toward the tire from above. The laser testing device (measuring probe, laser testing probe) can preferably be swiveled in order to scan a certain area, for example the entire inner area, of the tire and thereby test the tire, especially for faulty areas. If the testing apparatus is located inside a vacuum chamber, faulty areas are better emphasized due to the low pressure and can also be detected better and more reliably by the testing device and/or laser testing device.

[0003] The object of the innovation is to improve a testing apparatus of this type.

[0004] According to the innovation, this object is achieved in that the testing apparatus has several measuring heads and/or laser measuring heads. Because of this, the time required for testing the tire can be reduced.

[0005] Advantageous further developments are described in the subclaims.

[0006] The testing device is preferably mounted so that it can rotate. Instead of that, or additionally, the tire positioning device can be mounted so that it can rotate. Because of a rotation of the testing apparatus with the measuring heads found on it and/or of the positioning device with the tire to be tested, a relative movement and/or relative rotation between measuring heads and tire is achieved.

[0007] Advantageously here, the measuring heads are arranged with the same angular spacing with respect to each other. For example, three measuring heads can be provided, with angular spacing with respect to each other of 120° in each case. If two measuring heads are used, their angular spacing with respect to each other is preferably 180°; if there are four measuring heads, preferably 90° in each case. However, it is also possible to mount even more measuring heads. This increases the complication of the apparatus, but the test time can be decreased even more.

[0008] Another advantageous further development is characterized in that the measuring heads are mounted adjustably on the testing apparatus. Preferably each individual measuring head can be adjusted on the testing apparatus and each is mounted so that it can be locked in place. The adjustment can be automatic or manual. The measuring heads can be adjusted outwardly and inwardly, preferably in radial direction with respect to the testing device axis of rotation. Instead of this, or additionally, the measuring heads can be adjusted upward and downward, preferably parallel to the axes of rotation of the testing device and/or of the positioning device, which preferably run vertically. Instead of this, or additionally, the measuring heads can be adjustable in their orientation and/or in the orientation of the camera on each measuring head.

[0009] According to another advantageous further development, a mirror is provided. Preferably several mirrors are provided, preferably according to the number of measuring heads. By using appropriately arranged mirrors, areas of the tire can even be tested which would otherwise be difficult to access.

[00010] According to another aspect of the invention, the testing apparatus for tires is characterized in that at least one measuring head is provided with a number of observation units having illumination sources assigned to them.

[00011] The observation units are integrated into the measuring head. They can be mounted so that they move together with the illumination sources, as a unit. Due to the number of observation units in one measuring head, several areas of the tire to be tested can be observed and tested at the same time. Because of this, the cycle time required can be significantly reduced. Because of the integration into one measuring head each, the movement control of the observation units and/or illumination sources is simplified.

[00012]|In a further development of the invention, a number of illumination sources is assigned to each of the observation units. Preferably laser light sources are arranged in two rows, whereby each of the observation units is arranged between two rows of laser light sources. The arrangement of the illumination sources on different sides of the observation unit causes an illumination of the tire area to be tested from different directions and permits improved observation of the tire.

[00013] According to a preferred design of the invention, the measuring head has a modular structure. It consists of several combined measuring head segments, each with an observation unit having several illumination sources assigned to it.

[00014] Each of the observation units can have a camera.

[00015] According to an alternative embodiment, each of the observation units can have several cameras, whereby a beam splitter can also be connected before the camera, but does not have to be, which causes each camera to observe a separate area. The light reflected from the tire

surface is divided into several ranges by the beam splitter and supplied to the individual cameras. The cameras can also record individual areas separately. The observation area of the corresponding observation unit is thus divided into several observation areas by the beam splitter, so that each camera observes its own area. The lateral resolution of the observation unit is improved because of the arrangement of several cameras in one observation unit.

[00016] In a further development of the invention, the observation units and/or the illumination units are designed so that they can swivel around at least one axis and/or can be driven along at least one axis.

[00017] The observation units and/or the illumination sources can be moved with respect to the individual measuring head.

[00018] According to another embodiment of the invention, the observation units and/or the illumination sources can be moved together with the measuring head, as a unit.

[00019] Preferably each measuring head is designed so that it can be swiveled around and/or driven along several axes. This achieves a greater movement capability of the measuring head and the observation units and illumination sources integrated into it. The tire to be tested can be driven, whereby the measuring head can be brought into the position that is most favorable for testing the tire in each case.

[00020] The necessary relative movement between measuring head and tire can also be achieved by a corresponding movement of the positioning device for the tire to be tested. However, because of the weight of the tire and of the positioning device, it may be advantageous to move the measuring head. The necessary actuating drives can be built more easily and the driving movement can be produced more easily.

[00021] In a further development of the invention, at least one mirror can be assigned to each of the observation units and/or the illumination sources. With the use of this type of mirror, even areas of the tire that are difficult to access can be observed and/or tested. Preferably, each of the mirrors is designed so that it can swivel and/or be driven, especially around or along multiple axles, in order to be able to approach the tire surface accordingly.

[00022] According to another aspect of the present invention, the testing apparatus for tires is characterized in that a device for recording the size and/or the position of the tire is provided, as is a control device that positions the at least one measuring head according to the recorded size and/or position of the tire. Independently of the number of measuring heads and/or observation units and illumination sources, such an arrangement has the advantage that the testing procedure can be largely automated and the testing apparatus automatically adapts to the respective tire type. The control device automatically determines the necessary measuring head position and positions the measuring head or heads in such a way that the tire test can be carried out. Independently of the tire type, the measuring head is continuously brought automatically into the correct testing position relative to the tire. If necessary, the positioning can be carried out by a corresponding movement of the tire with the use of its positioning device. However, preferably the measuring heads are driven and swiveled into their test positions.

[00023] According to one embodiment of the invention, recording of the tire size and/or position can be carried out using an arrangement that determines the tire size, especially its diameter and width, using shadow projection. For this purpose, at least one illumination source is provided for illuminating the tire and one observation unit is provided that records the shadow projected from the tire. Preferably, in this case the tire is moved perpendicular to the illumination direction. Inner and outer diameter of the tire, and its width, can be determined from the movement of the tire and the shadows that are cast and vary in this process. The tire size can also be determined with other means, e.g. photoelectric barriers. Since the tire is transported into the apparatus, the movement of the tire can be used in connection with photoelectric barriers to determine the diameter.

[00024] In order to be able to record fabric damage in the tire, in a further development of the invention, the testing apparatus can have X-ray equipment for X-raying the tire.

[00025] In addition, a voltage tester with at least one electrode and an opposing piece that works together with it can be provided, whereby the electrode and the opposing piece can be positioned on different sides of the tire. The opposing piece can preferably be designed as a metal roller that follows the driving movement of the electrode on the opposite side of the tire with a rolling movement. If voltage, especially high voltage, is applied to the electrode, which can be designed as a wire strap, chain, etc., nail holes in the tire and other damage of this type can be detected easily.

[00026] |An advantageous design of the invention is further characterized in that a high pressure test is carried out to detect weaknesses in the carcass. The tire is exposed to high pressure by means of a high-pressure device. During the resulting inflation of the tire, the locations where the carcass is weak can easily be recognized since in this case there is a greater, bulge-like expansion.

[00027] In addition, a surface inspection of the inside for cracks can be carried out using a camera with image processing system.

[00028] Preferably the tire testing apparatus has a device for common results display of the various individual tests. The carcass evaluation permits a secure testing of the tire, based on several of the methods named.
[00029] Preferred embodiments of the invention will be described in detail below with the attached drawings. In the drawings:

Fig. 1 shows a side view of a testing apparatus for tires with a vacuum chamber, in open position, Fig. 2 shows the testing apparatus with vacuum chamber according to Fig. 1 in closed position, also in side view,

Fig. 3 shows a part of the testing apparatus in a view from above,

Fig. 4 shows a top view of a measuring head with several observation units and illumination sources assigned to it according to a preferred embodiment of the invention,

Fig. 5 shows a side view of the measuring head from Fig. 4,

Fig. 6 shows a schematic representation of a measuring head with observation units and illumination sources attached to it so that they can swivel, according to a preferred embodiment of the invention,

Fig. 7 shows a schematic representation of an individual measuring head, showing the movement capability of the measuring head,

Fig. 8 shows a schematic representation of a testing apparatus with several measuring heads according to a preferred embodiment of the invention, which shows the multi-axial movement capability of the individual measuring heads,

Fig. 9 shows an individual measuring head with an observation unit and assigned illumination sources that illuminate and observe the inner surface of the tire using a mirror,

Fig. 10 shows an observation unit with two cameras and with a beam splitter mounted in front of them according to a preferred embodiment of the invention, in which the visible area of the observation unit is divided between the two cameras,

Fig. 11 shows a schematic representation of the arrangement of an illumination source and of an observation unit for detecting the outer diameter of the tire using shadow projection,

Fig. 12 shows the arrangement of an illumination source and of an observation unit for determining the inner diameter of the tire in a view similar to Fig. 11,

Fig. 13 shows the arrangement of several illumination sources and two illumination screens for determining the inner and outer diameter of the tire, as well as its width, by means of shadow projection according to a preferred embodiment of the invention,

Fig. 14 shows an X-ray unit for X-raying the tire in order to recognize fabric damage in the tire, and

Fig. 15 shows a voltage testing unit for high-voltage current measurement for examining the tire according to a preferred embodiment of the invention.

[00030] Fig. 1 shows a testing apparatus for tires that has a measuring head 1 that is located in the inner area of a tire 3. The testing apparatus is surrounded by a vacuum chamber 2 that has a hood 4, which is mounted on sliding carriage 5 that can move vertically. Sliding carriage 5 can be moved vertically in a guide 6. It can be run down into the closed position shown in Fig. 2, in which the hood seals against table 7, which it contacts. In this position, a vacuum is created in the hood 4 by a vacuum pump (not shown in the drawing), so that faulty areas of the tire 3 can be detected better.
[00031] As can be seen in Fig. 3, the testing apparatus has a testing device 8 that consists of a table and four laser measuring heads 9, 10, 11, 12, which are arranged on table 8 with an angular spacing of 90° with respect to each other. The testing device 8 is mounted so that it can be turned around its vertical center axis 13.
[00032] The tire 3 lies on a table 14 that forms its positioning device, which in its center has a circular opening that is concentric with the vertical axis, within which the testing device 8 is located. The table 14 can be mounted so that it can be rotated. The testing device can also be moved into the tire from above.
[00033] Testing device 8 can be adjusted in vertical direction, i.e. along axis 13. It is first run downward below the level of the table 14. After the tire 3 has been placed on the table, the testing device 8 is moved upward in vertical direction into

the working position, in which it is located within the opening of table 14 and within tire 3. By a rotation of 90° around axis 13, all the laser measuring heads 9 - 12 can scan and test the entire inner area of tire 3.

[00034] Above the tire 3, mirrors 15 are arranged (only one mirror 15 is shown in Fig. 3 in order to simplify the drawing). One mirror 15 is assigned to each laser measuring head 9 - 12; the mirror shown in the drawing in Fig. 3 is assigned to the laser measuring head 11. Because of the mirror, it is possible to test the upper shell of the tire 3. The tire is turned to test the lower shell of the tire.

[00035] Measuring heads 9 - 12 are mounted on the testing device 8 so that they can be adjusted. They can be adjusted in radial direction, inward and outward with respect to the vertical axis. In addition, they can be adjusted upward and downward. Finally, the orientation of the cameras of the laser measuring heads 9 - 13 can be changed. For example, a change in the camera orientation can be used so that the camera "views" from top to bottom or from inside the tire toward the outside.

[00036] Because of the innovation, a further-developed tire testing apparatus is provided with the special feature that several measuring heads can be used at different positions. This saves testing time, since several sectors can be recorded and tested simultaneously or practically simultaneously. Besides that, the rotating process of the measuring head and/or of the tire is simplified since a relative rotation capability beyond 360° no longer has to be provided, but only an appropriately low relative rotation capability depending on the number of measuring heads used. The arrangement of the measuring heads can be selected in such a way that they record different sectors of the tire simultaneously or measure the tire simultaneously in different views or both. For example, using two measuring heads, two sectors of the tread of a tire can be tested simultaneously. However, it is also possible to simultaneously examine a view of the tread and a view in the bead or sidewall area.

[00037] Additionally, several measuring heads can also be turned around the tire axis 13. With the use of e.g. four measuring heads and an option for being able to turn these four measuring heads that are distributed uniformly on the circumference by 45°, eight sectors of the tire tread can be detected within the time that would otherwise be necessary for two individual recordings.

[00038] The number of measuring heads can be varied. For example, three measuring heads could be used in three positions or two measuring heads in two positions. According to another advantageous arrangement, two measuring heads can be used for the sidewall of the tire and two measuring heads for the tread of the tire.

[00039] Figures 4 and 5 show a measuring head according to a preferred embodiment of the invention, in which a number of observation units 16 and a number of illumination sources 17 are integrated. Preferably laser light sources are provided as illumination sources 17. The observation units 16 have one or more cameras, as will be explained later.

[00040] As Fig. 4 shows, the measuring head 18 is made up of four identical measuring head segments 19, 20, 21, 22, each of which has one observation unit 16 and 14 illumination sources 17. The observation units 16 are arranged diametrically opposed in pairs, the spacing between the observation units 16 is uniform and in this case is 45°.

[00041] In each measuring head segment, the illumination sources 17 are arranged in two rows parallel to each other, whereby in each case the associated observation unit 16 lies between the illumination sources 17 and/or views between the illumination sources (see Fig. 5).

[00042] The measuring head segments 19, 20, 21, 22 and/or the respective illumination units 16 and illumination sources 17 can be rigidly mounted on the measuring head 18 and mounted so that they can be moved and/or guided together with it as a unit. According to another version of the invention (see Fig. 6), however, it can also be provided that the individual measuring head segments, i.e. the individual observation units 16 with the illumination sources 17 assigned to them are mounted on the measuring head 18 so that they can move. In particular, the observation units 16 with the associated illumination sources can be mounted on the measuring head so that they can swivel around an axis. Because of this, on one hand, the measuring head 18 can be driven and/or turned and swiveled as a whole with the observation units 16 and illumination sources 17 integrated into it. On the other hand, the observation units 16 can still be swiveled relative to the measuring head 18 and aligned to the tire surface to be passed over, permitting an optimal observation of the tire surface to be tested. As Fig. 6 shows, the swivel axes 23 of measuring head segments 19, 20, 21 and 22 lie in the rotation plane of tire 3, namely in tangential direction with respect to a hypothetical circle around the tire axis of rotation. The measuring head 18 itself can be driven along an axis 24 that is perpendicular to the rotation plane of tire 3, i.e. it is height-adjustable when the tire is lying down. In addition, the measuring head 18 can be turned, as a whole, around axis 24, so that the observation units 16 can examine the inner surface of the tire 3.

[00043] The drives for driving the measuring head 18 can be located inside or outside the tire 3. Fig. 7 shows a version of the invention in which the measuring head 18 is mounted on a gantry 25. A bracket 26 that extends down from the gantry 25 for the measuring head 18 can be driven on gantry 25 in two axes, namely along the axis designated with 27 in Fig. 7 and along an axis perpendicular to it. In addition, the bracket 26 can be turned around its longitudinal axis and/or around an axis perpendicular to the contact surface of the positioning device 14 for the tire 3. The measuring head 18 can be driven back and forth along with the bracket 26 along axis 28. The height adjustment capability of the measuring head 18 along axis 28 can be carried out by adjustment of the bracket 26 itself, especially by longitudinal adjustment of the bracket 26. As Fig. 7 shows, the measuring head 18 fastened on bracket 26 can also be swiveled around an axis 29. The swivel axis 28 of measuring head 18 is preferably perpendicular to the rotary axis of bracket 26.

[00044] The measuring head 18, or possibly a number of measuring heads, is thus arranged above the tire and attached and mounted from above. As Fig. 7 shows, the suspended mounting of the measuring head allows a simplified design of the base on which the tire is supported. The base 14 can especially be designed so that it is continuous, for example as a single plate. No recesses, openings or the like have to be provided in the base, in which the measuring head can be held and through which the measuring head can be driven (see Fig. 7).

[00045] In order to carry out the tire testing in the shortest possible time, several measuring heads 18 can be provided, which are also each mounted so that they can move along more than one axis. As Fig. 8 shows, three measuring heads 18 can be provided, of which two test the inside of the tire carcass and one its outside. Preferably, the measuring heads are fastened to a bracket 26, which can be mounted on a gantry, similarly to the design described above. The bracket 26 can be adjusted in height along axis 28 in the manner described above and can rotate around its longitudinal axis. The measuring heads 18 are each fastened on a bracket 26 so that they can be moved along more than one axis. For one thing, they can be driven along radial axis 30, i.e. their distance from bracket 26 can be adjusted. In this way, the testing apparatus can be adapted and/or adjusted to different tire diameters. In addition, all measuring heads are mounted on an extension 31 by means of which they are connected to the bracket 26, so that they can each swivel around one swivel axis 29. The swivel axes of measuring heads 18 preferably extend tangentially to hypothetical circles around the rotation axis of tire 3. In addition, the measuring heads 18 are height-adjustable with respect to the bracket 26 for inspection of the inside of tire 3, and namely along axes indicated with 32 in Fig. 8, which extend parallel to the adjusting axis 28 of bracket 26. The measuring heads 18 can thus be adjusted in height, together by means of the bracket 26, and in addition a height adjustment of the measuring heads 18 can be carried out relative to the bracket 26, along axis 32.

[00046] The extensive adjustment capability of the measuring heads 18 separately or simultaneously permits, for one thing, an optimal setting of the individual measuring heads to the tire section to be tested. For another, after individual calibration, the tire can be driven with a simple kinematic control, namely a rotation of the bracket 26 around its longitudinal axis.

[00047] The illumination and/or the observation of the tire surface can also be carried out using mirrors. To do this, a mirror 33 is assigned to each observation unit 16 and the associated illumination sources 17, this mirror 33 casting the light coming from the illumination sources 17 onto the tire area to be observed. The observation units 16 also observe the illuminated area by way of the mirror 33. As Fig. 9 shows, this mirror 33 can be arranged on the inside of the tire, in order to test the inside of the tire. In an advantageous manner, the mirror can be driven along and swiveled around more than one axis in order to be exactly calibrated in such a way that the desired area of the tire can be illuminated and observed in each case. With the use of such a mirror 33, poorly accessible areas, in which the relatively bulky measuring head 18 can only be positioned with difficulty, can be observed and tested.

[00048] In order to improve the lateral resolution of the observation units 16, these can each have two cameras 34, in front of which a beam splitter 35 is connected, as Fig. 10 shows. The beam splitter 35 divides the area to be observed by observation unit 16 into two areas, each of which is observed by a camera 34. In Fig. 10, the upper half 36 of the observation area for the upper camera 34 and the lower half 37 of the observation area of the inside of the tire for the camera 34 that is on the bottom in Fig. 10 can be seen. Although it is not shown in Fig. 10, the two cameras 34 and the beam splitter 35 and the optics 38 connected in front of it are effectively combined to form one unit that is integrated into the corresponding measuring head 18.

[00049] In order to automate the testing procedure as much as possible, the testing apparatus adjusts itself automatically to different types of tires. To do this, the tire size and the position of the tire on the positioning device are recorded and the necessary measuring head positions are determined automatically. Preferably the determination of the outer and inner diameter, and the width of the tire, are carried out using shadow projection.

[00050] According to a preferred embodiment of the invention, to do this an illumination source 39 is arranged on one side of tire 3 and an observation

unit 40 is arranged on another side of the tire. The observation unit 40 is arranged here in such a way that it records the light arriving on the side of tire 3 that is opposite the illumination source 39 when the tire does not obstruct the light coming from illumination source 39. As Fig. 11 shows, this can also be carried out by means of a mirror 41 that is arranged diametrically opposed to illumination source 39 and that deflects the light coming from illumination source 39 to observation unit 40.

[00051] The tire 3 is moved across the direction of the light propagated from illumination source 39 and guided through the corresponding light beam. The outer diameter of tire 3 can be determined from the duration of the shadow cast by the tire 3 and the movement speed and/or from the path of the tire. Instead of the movement of tire 3, the illumination source 39 with the mirror 41 and/or the observation unit 40 can also be moved.

[00052] Fig. 12 shows the arrangement of another illumination source, another mirror and another observation unit to determine the inner diameter of tire 3. The arrangement is made in such a way that the light beam can pass through the inner recess of tire 3. Tire 3 can be moved, in turn, laterally to the direction of the light beam. Otherwise the arrangement according to Fig. 12 corresponds to the principle shown in Fig. 11.

[00053] The size and/or position of tire 3 can also be determined with the use of a number of illumination sources 42. As Fig. 13 shows, in this arrangement, a first row of illumination sources 42 is arranged on a first side of tire 3, whereby the row is longer than the maximum diameter of tire 3. A second row of illumination sources 43 is arranged on the side of the tire opposite its circumference surface, whereby the row is longer than the maximum width of tire 3. Screens 44 and 45 on the opposite sides of tire 3 are assigned to illumination sources 42 and 43, respectively, each of which records the light that goes past the tire from the outside and/or the light passing through the inner recess of tire 3. The width, inner diameter and outer diameter of the tire 3 can be determined from the shadow cast.

[00054] A control device not shown in the figures evaluates the data representing the size and position of the tire and controls the drives of the measuring heads in such a way that the measuring heads are automatically driven to their respective test positions. In this case, the tire 3 can also be moved appropriately if necessary.

[00055] In order to achieve complete testing of the tire, in addition to the optical observation and/or testing device, the testing apparatus has still other testing units.

[00056] In a further development of the invention, an X-ray device 46 can especially be provided. This can have an X-ray head 47 with an X-ray source 48 arranged in it, as well as a detector 49 that cooperates with it. Effectively, the X-ray head 47 and the detector 49 that works with it can be positioned on opposite sides of the tire carcass so that the tire wall can be penetrated by the X-rays. In this case, the X-ray head 47 and the detector 49 can be driven in such a way that all of the tire wall can be scanned. If necessary, the tire can also be moved appropriately. Effectively, the X-ray head 47 is moved to position it. The scanning of the tire is then accomplished by a rotation of the tire around its axis of rotation. With the help of such an X-ray device, fabric damage in the tire can be recorded (see Fig. 14).

[00057] In a further development of the invention, a voltage testing device 50 can be provided for high-voltage current measurement of e.g. nail holes in tire 3. As Fig. 15 shows, the voltage testing device 50 has a high-voltage electrode 51 that can be designed as wire strap, chains, etc., and a metal roller 52 that works together with the high-voltage electrode 51. The high-voltage electrode 51 and the metal roller 52 can be positioned on opposite sides of tire 3 in such a way that the tire wall comes to rest between the high-voltage electrode 51 and the metal roller 52. Because of a corresponding relative movement between the tire 3 and the high-voltage electrode 51, as well as the metal roller 52, the tire is driven, whereby electrode 51 and metal roller 52 remain opposite each other at all times. When there are nail holes and the like, voltage breakdowns occur that indicate the corresponding damage in the tire.

[00058] In addition, although this would not be shown in the drawings, tire 3 can be subjected to a high pressure test for carcass weaknesses or a surface inspection of the inside for cracks, by means of a camera with image processing system. A device that can provide a common results display of the different individual tests and can carry out the corresponding carcass evaluation is also not shown in the drawings.

Patent Claims

1. Testing apparatus for tires with a positioning device (14) for the tire (3) to be tested and with a testing device (8), especially a laser testing device,

characterized in that the testing device (8) comprises several measuring heads (9, 10, 11, 12), especially laser measuring heads.

2. Testing apparatus according to Claim 1, characterized in that the testing device (8) and or the positioning device (4) is mounted so that it can rotate.

3. Testing apparatus according to Claim 1 or 2, characterized in that the measuring heads (9 - 12) are arranged with the same angular spacing with respect to each other.

4. Testing apparatus according to one of the preceding claims, characterized in that the measuring heads (9 - 12) are mounted on the testing device 8 so that they can be adjusted.

5. Testing apparatus according to one of the preceding claims, characterized in that one or more mirrors (15) are provided.

6. Testing apparatus according to the preamble of Claim 1, characterized in that at least one measuring head (18) with a number of observation units (16) having illumination sources (17) assigned to them is provided.

7. Testing apparatus according to the preceding claim, wherein a number of illumination sources (17) are assigned to each of the observation units (16), whereby preferably each of the observation units (16) is arranged between two rows of laser light sources.

8. Testing apparatus according to one of the preceding claims, wherein the measuring head (18) has a modular construction.

9. Testing apparatus according to one of the preceding claims, wherein each observation unit (16) has at least one camera.

10. Testing apparatus according to one of the preceding claims, wherein each observation unit (16) has several cameras (34).

11. Testing apparatus according to one of the preceding claims, wherein the observation units (16) and/or the illumination sources (17) can be moved as a unit together with the measuring head (18).

12. Testing apparatus according to one of the preceding claims, wherein the observation units (16) and/or the illumination sources (17) can be moved relative to the measuring head (18).

13. Testing apparatus according to one of the preceding claims, wherein the observation units (16) and/or the illumination sources (17) are designed so that they can be swiveled around at least one axis and/or driven along at least one axis.

14. Testing apparatus according to one of the preceding claims, wherein each measuring head (18) is designed so that it can swivel around and move along several axes (27, 28, 29, 30, 32).

15. Testing apparatus according to one of the preceding claims, wherein at least one mirror (33) is assigned to each of the observation units (16) and/or illumination sources (17), whereby preferably the mirror is designed so that it can swivel and/or be driven.

16. Testing apparatus according to one of the preceding claims, wherein a device (39, 40, 41; 42, 43, 44, 45) for recording the size and/or position of the tire (3) and a control device that positions the at least one measuring head (18) according to the recorded size and/or position of the tire, are provided.

17. Testing apparatus according to one of the preceding claims, wherein the device has at least one illumination source (39; 42, 43) for illuminating the tire (3) and one observation unit (40; 44, 45) that records the shadow projected by the tire (3).

18. Testing apparatus according to one of the preceding claims, wherein an X-ray device (40) is provided for X-raying the tire (3).

19. Testing apparatus according to one of the preceding claims, wherein a voltage testing device (50) with at least one electrode (51) and an opposing piece (52) that works together with it are provided, whereby the electrode and the opposing piece can be positioned on different sides of the tire.

20. Testing apparatus according to one of the preceding claims, wherein a high-pressure device is provided for stressing the tire (3) with high pressure.

21. Testing apparatus according to one of the preceding claims, wherein a surface testing device with a camera and an image processing connected to it is provided.

22. Testing apparatus according to one of the preceding claims, wherein a device is provided for common results display of different individual tests.

(Note: Insert Figures 1 – 15)